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(54) **Title:** SURGICAL BONE CLAMP

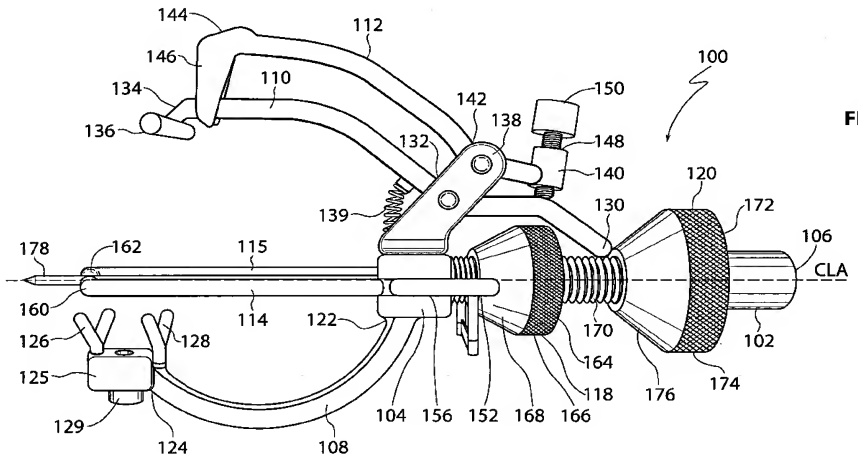

FIG. 1

(57) **Abstract:** A surgical instrument (100) for clamping to a ball end of a femur. The instrument includes a body (102) and first (108), second (110) and third (112) clamping arms. The body (102) has a central longitudinal axis (CLA). The first clamping arm (108) is connected to the body (102) and has a proximal end (122) and a distal end (124). The second clamping arm (110) is connected to the body (102) and has a proximal end (130) and a distal end (134). The third clamping arm (112) is connected to the body (102) and has a proximal end (140) and a distal end (144). The distal ends of at least two of the first (108), second (110) and third (112) clamping arms are moveable toward the central longitudinal axis (CLA) of the body (102) to permit the surgical instrument (100) to clamp around at least a portion of the ball end of the femur. The at least two clamping arms are independently moveable relative to one another.

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SURGICAL BONE CLAMP

Field of the Invention

The present invention relates to improvements in surgical instruments designed to clamp onto a bone such as the ball end of a femur.

Background of the Invention

A trend in hip surgery is to preserve as much of the ball end of the femur as possible. To help facilitate this trend, surgical clamps have been developed to attempt to clamp onto the ball end of the femur to act as a guide for a drill or reamer to create a space in the femoral head for the implantation of an implant. One problem with conventional bone clamps is that due to the geometry of the femoral neck, the forces supplied by opposed clamping surfaces of a surgical clamp are usually offset relative to one another. This can result in undesirable movement of the clamp as the surgeon is attempting to fix the location for the drill or reamer.

There thus exists a need to provide an improved surgical clamp more suited to the geometry of the bone to which it is adapted to clamp.

The reference to any prior art in this specification is not, and should not be taken as an acknowledgement or any form of suggestion that the referenced prior art forms part of the common general knowledge in Australia.

Summary of the Invention

Accordingly, in a first aspect, the present invention provides a surgical instrument for clamping to a ball end of a femur, said instrument including:

a body having a central longitudinal axis;

a first clamping arm connected to said body and having a proximal end and a distal end;

a second clamping arm connected to said body and having a proximal end and a distal end; and

a third clamping arm connected to said body and having a proximal end and a distal end, said distal ends of at least two of said first, second and third clamping arms being moveable toward the central longitudinal axis of said body to permit the surgical instrument to clamp around at least a portion of the ball end of the femur, said at least two clamping arms being independently moveable relative to one another.

In a second aspect, the present invention provides a surgical instrument for clamping to a ball end of a femur, said instrument including:

a body having a central longitudinal axis;

a first clamping arm connected to said body and having a proximal end and a distal end;

a second clamping arm connected to said body and having a proximal end and a distal end; and

a third clamping arm connected to said body and having a proximal end and a distal end, said first, second and third clamping arms each having a mid-longitudinal axis in a common plane, at least two of said clamping arms being moveable within the common plane to permit the surgical instrument to clamp around at least a portion of the ball end of the femur.

The first clamping arm is preferably fixedly connected to said body.

The surgical instrument preferably further includes a fourth clamping arm connected to said body and having a proximal and a distal end, said distal end being moveable toward the central longitudinal axis of said body.

The surgical instrument preferably further includes a fifth clamping arm connected to said body and having a proximal and a distal end, said distal end being moveable toward the central longitudinal axis of said body.

At least two of said clamping arms are preferably in a first plane and at least another two of said clamping arms are in a second plane, the first and second planes being approximately 90 degrees relative to one another.

The surgical instrument preferably further includes an actuator adapted to move at least in part around the central longitudinal axis of the body to move said distal end of at least one of said clamping arms toward the central longitudinal axis of said body.

The actuator is preferably adapted to move at least two of said clamping arms.

The surgical instrument preferably further includes a second actuator adapted to move at least in part around the central longitudinal axis of the body to move said distal end of another of said clamping arms toward the central longitudinal axis of said body.

The actuator is preferably a cam wheel.

In a third aspect, the present invention provides a method for clamping a ball end of a femur, the ball end of the femur having a femoral head and a femoral neck, the femoral head having a lower hemisphere oriented toward the femoral neck and an upper hemisphere opposite the lower hemisphere, the femoral neck having an upper surface between the femoral head and the piriformis, the femoral neck having a lower surface at least in part opposite the upper surface, said method including:

positioning a surgical clamp relative to the femoral head;

contacting a portion of the lower surface of the femoral neck with a portion of the surgical clamp;

contacting a portion of the upper surface of the femoral neck with a portion of the surgical clamp; and

contacting a portion of the lower hemisphere of the femoral head with a portion of the surgical clamp to align an opening in the surgical clamp relative to the upper hemisphere of the femoral head.

The steps of contacting the upper surface of the femoral neck and portion of the lower hemisphere preferably include moving two portions of the surgical clamp in the same plane.

The method preferably further includes contacting a side surface of the femoral neck with a portion of the surgical clamp.

In a fourth aspect, the present invention provides a method for clamping a ball end of a femur, the ball end of the femur having a femoral head and femoral neck, said method including:

positioning a surgical clamp relative to the femoral head;

contacting a first portion of the femoral neck with a portion of the surgical clamp;

contacting a second portion of the femoral neck with a portion of the surgical clamp; and

contacting a third portion of the femoral neck with a portion of the surgical clamp to align an opening in the surgical clamp relative to an upper hemisphere of the femoral head, the steps of contacting being conducted non-simultaneously relative to one another.

The method preferably further includes the step of contacting a fourth portion of the femoral neck with a portion of the surgical clamp to align the opening in the surgical clamp relative to the upper hemisphere of the femoral head.

In a fifth aspect, the present invention provides a method for clamping a ball end of a femur, the ball end of the femur having a femoral head and femoral neck, said method including:

positioning a surgical clamp relative to the femoral head, the surgical clamp having a central longitudinal axis and at least two clamping arms each having a distal end adapted to contact the femur;

rotating a portion of the surgical clamp about the central longitudinal axis to move the distal end of at least one of the clamping arms towards the central longitudinal axis of the surgical clamp; and

rotating another portion of the surgical clamp to move the distal end of at least another one of the clamping arms towards the central longitudinal axis of the surgical clamp.

In a sixth aspect, the present invention provides use of a surgical bone clamp according to the first or second aspect at the ball end of a femur.

Brief Description of the Drawings

A preferred embodiment of the present invention will now be described, by way of an example only, with reference to the accompanying drawings wherein:

Fig. 1 is a partially rotated side view of an embodiment of a surgical clamp;

Fig. 2 is a perspective front view of the surgical clamp of Fig. 1.

Fig. 3 is a side elevation view of a cradle arm and side clamping arms of the surgical clamp of Fig. 1 engaged with the ball end of a femur;

Fig. 4 is a side elevation view of an upper clamping arm of the surgical clamp of Fig. 1 engaged with the ball end of the femur;

Fig. 5 is a side elevation view of a locating arm of the surgical clamp of Fig. 1 engaged with the ball end of the femur;

Fig. 6 is a side elevation view of the surgical clamp of Fig. 1 engaged and tightened to the ball end of the femur; and

Fig. 7 is a side elevation view of the surgical clamp of Fig. 1 in an engaged position with an alignment pin extending from a portion of the surgical clamp.

Detailed Description of the Preferred Embodiment

Alternative embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the claims which follow. References to "upper" and "lower" are for illustrative convenience only as would be appreciated by a person skilled in the art.

Figs. 1 and 2 show a preferred embodiment of a surgical bone clamp 100 having a body 102 with a leading end 104 and a trailing end 106, a cradle arm or first clamping arm 108, an upper clamping arm or second clamping arm 110, a locating arm or third clamping arm 112, a pair of opposed side clamping arms 114, 116, and a pair of cam wheels or first and second actuators 118, 120. To engage the surgical clamp with the ball end of the femur, cradle arm 108 is positioned along the lower femoral neck, cam wheel 118 is rotated to bring side clamping arms 114 and 116 into engagement with the sides of the femoral neck and cam wheel 120 is rotated to bring clamping arm 110 into engagement with the upper portion of the femoral neck. Locating arm 112 is engaged with a portion of the lower hemisphere of the femoral head by adjusting a turn screw at one end of the locating arm. The preferred elements of clamp 100 and their interrelationship are described in more detail below.

Referring to Fig. 2, body 102 preferably includes an opening 121 preferably centred at the central longitudinal axis CLA that preferably extends along the length of body 102 as a passage between ends 104, 106. The opening is preferably configured for passage of a medical instrument therethrough such as a drill or reamer.

Cradle arm 108 includes a proximal end 122 attached to leading end 104 of body 102, and a distal end 124 having a detachable cradle member 125. Cradle member 125 includes an upper portion with a pair of generally V-shaped engagement members 126, 128 which are preferably configured for engagement with the lower femoral neck of the femur. The thickness, height and spacing of V-shaped engagement members 126, 128 relative to one another may be varied without departing from the scope of the present

invention. It will be appreciated that other engagement means may be used such as surface projections forming, for example, spikes or knurling. The engagement means may be varied in number, for example, having only one V-shaped member or three or more V-shaped members. Cradle member 125 has a lower portion which preferably includes a finger pad 129 extending therefrom as shown in Fig. 1. Cradle member 125 may be integral with cradle arm 108 or omitted altogether if desired with engagement means projecting directly from the arm itself. The detachability of cradle member 125 is advantageous for allowing surgical clamp 100 to be fitted with one of a range of differently sized or configured cradle members suitable for the characteristics of the bone to which the clamp is to be applied. Such differently sized and configured cradle members may be included in a kit with the surgical clamp.

Cradle arm 108 is preferably in fixed relationship to body 102. Cradle arm 108 is preferably curved along most of the length of the arm to avoid contact with the femoral head when the clamp is engaged to the ball end of the femur. Cradle arm 108 may include generally straight sections or be differently curved without departing from the scope of the present invention.

As shown in Fig. 1, upper clamping arm 110 includes a proximal end 130, and attachment portion 132 and a distal end 134. Distal end 134 includes an engagement member preferably formed as a bar 136 transverse to the length of arm 110. It will be appreciated that other engagement means may be used such as surface projections forming, for example, spikes or knurling. Additionally, the number, shape, size and configuration of the engagement means may be varied as desired.

As shown in Fig. 2, upper clamping arm 110 is preferably attached to body 102 between two flanges 137, 138 with a pin through attachment portion 132 of arm 110. Attachment portion 132 is preferably positioned along the length of upper clamping arm 110 to allow upper clamping arm 110 to pivot in response to the movement of locking cam wheel 120 against proximal end 130. It will be appreciated that other attachment means may be used to attach upper clamping arm 110 to body 102. A spring 139 interposed between attachment portion 132 and a portion of body 102 between flanges 137, 138 preferably biases distal end 134 of upper clamping arm 110 away from the central longitudinal axis of body 102. Other biasing means may be used without departing from the scope of the present invention.

Referring to Fig. 1, locating arm 112 includes a proximal end 140, an attachment portion 142 and a distal end 144. The distal end of locating arm 112 includes an engagement member preferably configured as a fork 146. Fork 146 is preferably shaped to straddle a portion of upper clamping arm 110 when locating arm 112 is brought into

close proximity with upper clamping arm 110. The ends of fork 146 are configured to engage bone such as the lower hemisphere of the femoral head. It will be appreciated that other engagement means may be used such as surface projections forming, for example, spikes or knurling. Additionally, the number, shape, size and configuration of the engagement means may be varied as desired.

Proximal end 140 of locating arm 112 preferably includes a passage 148 having a mid-longitudinal axis intersecting the length of the arm. Passage 148 is preferably threaded to receive a turn screw 150 therethrough to selectively adjust the positioning of locating arm 112 relative to upper clamping arm 110, as will be further described below. Other means for adjusting the position of locating arm 112 may be utilised without departing from the scope of the present invention. For example, locating arm 112 may have a length longer than that of upper clamping arm 110 for engagement with a cam wheel rotatable about the central longitudinal axis of body 102.

As shown in Figs. 1 and 2, locating arm 112 is preferably attached to body 102 between flanges 137, 138 with a pin such as used to attach upper clamping arm 110. Attachment portion 142 is preferably positioned along the length of locating arm 112 to allow locating arm 112 to pivot in response to contact of one end of turn screw 150 with the surface of upper clamping arm 110. It will be appreciated that other attachment means may be used to attach upper clamping arm 110 to body 102.

Referring to Fig. 1, opposed side clamping arms 114, 116 each respectively include proximal ends 152, 154, attachment portions 156, 158 and distal ends 160, 162. Distal ends 160, 162 are preferably blunt-shaped, but it will be appreciated that the distal ends of opposed side clamping arms 114, 116 may be otherwise shaped as desired. Side clamping arms 114, 116 are each preferably attached to body 102 between two flanges in a manner similar to that described above with respect to the attachment of upper clamping arm 110 and locator arm 112 to body 102. Attachment portions 156, 158 are each preferably positioned along the length of the respective clamping arm to allow the clamping arm to pivot in response to the rotation of side arm cam wheel 118 against proximal ends 152, 154. It will be appreciated that other attachment means may be used to attach side clamping arms 114, 116 to body 102.

Side arm cam wheel 118 includes an upper portion 164, a side 166 and a lower portion 168 as shown in Fig. 1. Cam wheel 118 further includes a passage along its length between upper portion 164 and lower portion 168. The passage is preferably threaded to cooperate with an external thread 170 on body 102. Side 166 may be knurled or otherwise configured for engagement with a user's fingers as desired. Lower portion 168 preferably has a partially frustoconical shape for engagement with proximal ends

152, 154 of side clamping arms 114, 116, respectively. Lower portion 168 is preferably smooth so that as cam wheel 118 moves toward leading end 104 of body 102, proximal ends 152, 154 of side clamping arms 114, 116, respectively, slide against lower portion 168, forcing proximal ends 152, 154 away from the central longitudinal axis of body 102. Lower portion 168 has a slope angle preferably in the range of 10 to 45 degrees relative to the central longitudinal axis, more preferably 25 to 35 degrees. The range described above may include a subset of ranges therein without departing from the scope of the present invention.

Referring to Fig. 1, locking cam wheel 120 includes an upper portion 172, a side 174, a lower portion 176 and a passage along its length between upper portion 172 and lower portion 176. Locking cam wheel 120 is configured similar to cam wheel 118 except that it is of greater diameter than cam wheel 118 and lower portion 176 includes a greater slope angle relative to the central longitudinal axis of body 102. For example, the slope angle of lower portion 176 is preferably in the range of 30 to 60 degrees, more preferably approximately 45 degrees. The ranges described above may include a subset of ranges therein without departing from the scope of the present invention. Cam wheel 120 interacts with proximal end 130 of upper clamping arm 110 in a manner similar to the interaction of cam wheel 118 with proximal ends 152, 154 of side clamping arms 114, 116.

Having described the preferred components of the surgical bone clamp, a preferred method of use will now be described with reference to Figs. 3 to 6. Prior to engaging the surgical clamp, the surgeon selects a cradle attachment sized for the femoral neck of the patient as indicated in an image such as an x-ray. After selecting an appropriately sized cradle, the surgeon positions the clamp and holds the cradle firmly against the lower femoral neck as shown in Fig. 3.

Still referring to Fig. 3, the surgeon rotates side clamping arm cam wheel 118 about the central longitudinal axis of body 102 to move the cam wheel toward leading end 104. The movement of cam wheel 118 toward leading end 104 causes proximal ends 152, 154 of side clamping arms 114, 116 to slide along lower portion 168 and forces proximal ends 152, 154 away from the central longitudinal axis of body 102. The movement of proximal ends 152, 154 away from the central longitudinal axis causes side clamping arms 114, 116 to pivot about their respective pins and forces distal ends 160, 162 towards the central longitudinal axis until they contact or touch the side portion of the femoral neck. Bringing the side clamping arms into contact with the femoral neck brings the drill line to the centre of the femoral neck from a horizontal perspective.

With reference to Fig. 4, the surgeon rotates locking cam wheel 120 about the central longitudinal axis of body 102 to move the cam wheel toward leading end 104. The movement of locking cam wheel 120 toward leading end 104 causes proximal end 130 of upper clamping arm 110 to slide along lower portion 176 and forces proximal end 130 away from the central longitudinal axis of body 102. The movement of proximal end 130 away from the central longitudinal axis causes upper clamping arm 110 to pivot about the pin and forces distal end 134 towards the central longitudinal axis until bar 136 contacts or touches the upper portion of the femoral neck.

As shown in Fig. 5, turn screw 150 is rotated so that the bottom of the screw contacts upper clamping arm 110. Continued rotation of screw 150 causes proximal end 140 of locating arm 112 to move away from the central longitudinal axis of body 102 and pivots locating arm 112 so that distal end 144 moves toward the central longitudinal axis until fork 146 contacts or touches a portion of the lower hemisphere of the femoral head.

Preferably once arms 108, 110 and 112 are touching the bone and after the proper positioning of the clamp has been achieved, the surgeon rotates locking cam wheel 120 to move cam wheel 120 further toward leading end 104 to tighten and lock the arms against the bone as shown in Fig. 6.

As shown in Fig. 7, the surgeon may engage alignment pin 178 along one side thereof to check the final alignment if desired. The alignment pin should point to the intertrocanteric crease when the clamp is properly positioned such as shown in Fig. 7.

It will be appreciated that the steps described above may be performed in a different order, varied, or some steps omitted entirely without departing from the scope of the present invention. For example, arms 110 and 112 may be engaged with the bone prior to engagement of side clamping arms 114, 116 with the bone. Engagement of side clamping arms may be omitted if desired. The use of alignment pin 178 may be omitted if desired.

Bone clamp 100 is preferably constructed from a material suitable for the surgical environment such as glass bead blasted, 420 grade stainless steel. Other materials are within the scope of the present invention, for example, titanium.

The foregoing description is by way of example only, and may be varied considerably without departing from the scope of the present invention. For example only, cradle arm 108 may be configured to be moveable relative to body 102 in a fashion similar to that described with regard to arms 110, 112. The distal ends of any one of or all of the arms may be configured to engage the femoral head, for example, the lower hemisphere of the femoral head. The arms may be triangulated at 120 degree intervals rather than at 90 degree intervals about the femoral neck.

Other means for moving the arms are envisaged within the scope of the present invention. For example, the cams may be configured to slide along the longitudinal axis of the body using one or more tracks rather than being configured for rotation around the central longitudinal axis. One or more spring locks or ratcheting may be used to selectively lock the position of the cam and an associated one or more clamping arms. The clamping arms may be moved into position with a push button pivot arrangement in place of a cam if desired.

The cam wheels may be configured to be stationary relative to the length of the body and rotatable about the central longitudinal axis of the body within a circular groove or projection on the exterior of the body. The exterior of the lower portion of each cam wheel may include a spiral groove or thread so that when the cam wheel is rotated, the proximal end of an associated one or more clamping arms is forced along the groove and away from the central longitudinal axis of the body. Rotating the cam wheel in the opposite direction forces the proximal end of the associated one or more clamping arms toward the central longitudinal axis (and unclamps the bone clamp).

Clamping means other than clamping arms may be used. For example, a radially contracting distal collar may be used to provide a clamping force.

The features described with respect to one embodiment may be applied to other embodiments, or combined with or interchanged with the features of other embodiments, as appropriate, without departing from the scope of the present invention.

The present invention in a preferred form provides the advantages of improved positioning and securing. The enhanced securing of the clamp to the bone provides added reliability and permits the surgeon to focus on other operations, such as bone shaping or boring, with more certainty. A further advantage is the greater ease of operation of the instrument due in part to the less complicated arrangement of elements.

It will be appreciated that the bone clamp described above may be configured for use with other types of bone structures, particularly where there is difficulty in clamping to a multi-angled bone structure.

It will of course be realised that the above has been given only by way of illustrative example of the invention and that all such modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as herein set forth.

CLAIMS:

1. A surgical instrument for clamping to a ball end of a femur, said instrument including:

a body having a central longitudinal axis;

a first clamping arm connected to said body and having a proximal end and a distal end;

a second clamping arm connected to said body and having a proximal end and a distal end; and

a third clamping arm connected to said body and having a proximal end and a distal end, said distal ends of at least two of said first, second and third clamping arms being moveable toward the central longitudinal axis of said body to permit the surgical instrument to clamp around at least a portion of the ball end of the femur, said at least two clamping arms being independently moveable relative to one another.

2. A surgical instrument for clamping to a ball end of a femur, said instrument including:

a body having a central longitudinal axis;

a first clamping arm connected to said body and having a proximal end and a distal end;

a second clamping arm connected to said body and having a proximal end and a distal end; and

a third clamping arm connected to said body and having a proximal end and a distal end, said first, second and third clamping arms each having a mid-longitudinal axis in a common plane, at least two of said clamping arms being moveable within the common plane to permit the surgical instrument to clamp around at least a portion of the ball end of the femur.

3. The surgical instrument of either claim 1 or 2, wherein said first clamping arm is fixedly connected to said body.

4. The surgical instrument of either claim 1 or claim 2, further including a fourth clamping arm connected to said body and having a proximal and a distal end, said distal end being moveable toward the central longitudinal axis of said body.

5. The surgical instrument of claim 4, further including a fifth clamping arm connected to said body and having a proximal and a distal end, said distal end being moveable toward the central longitudinal axis of said body.

6. The surgical instrument of either claim 4 or claim 5, wherein at least two of said clamping arms are in a first plane and at least another two of said clamping arms are in a second plane, the first and second planes being approximately 90 degrees relative to one another.

7. The surgical instrument of any one of claims 1 to 6, further including an actuator adapted to move at least in part around the central longitudinal axis of the body to move said distal end of at least one of said clamping arms toward the central longitudinal axis of said body.

8. The surgical instrument of claim 7, wherein said actuator is adapted to move at least two of said clamping arms.

9. The surgical instrument of either claim 7 or claim 8, further including a second actuator adapted to move at least in part around the central longitudinal axis of the body to move said distal end of another of said clamping arms toward the central longitudinal axis of said body.

10. The surgical instrument of any one of claims 7 to 9, wherein said actuator is a cam wheel.

11. A method for clamping a ball end of a femur, the ball end of the femur having a femoral head and a femoral neck, the femoral head having a lower hemisphere oriented toward the femoral neck and an upper hemisphere opposite the lower hemisphere, the femoral neck having an upper surface between the femoral head and the piriformis, the femoral neck having a lower surface at least in part opposite the upper surface, said method including:

positioning a surgical clamp relative to the femoral head;

contacting a portion of the lower surface of the femoral neck with a portion of the surgical clamp;

contacting a portion of the upper surface of the femoral neck with a portion of the surgical clamp; and

contacting a portion of the lower hemisphere of the femoral head with a portion of the surgical clamp to align an opening in the surgical clamp relative to the upper hemisphere of the femoral head.

12. The method of claim 11, wherein said steps of contacting the upper surface of the femoral neck and portion of the lower hemisphere include moving two portions of the surgical clamp in the same plane.

13. The method of either claim 11 or claim 12, further including contacting a side surface of the femoral neck with a portion of the surgical clamp.

14. A method for clamping a ball end of a femur, the ball end of the femur having a femoral head and femoral neck, said method including:

positioning a surgical clamp relative to the femoral head;

contacting a first portion of the femoral neck with a portion of the surgical clamp;

contacting a second portion of the femoral neck with a portion of the surgical clamp; and

contacting a third portion of the femoral neck with a portion of the surgical clamp to align an opening in the surgical clamp relative to an upper hemisphere of the femoral head, the steps of contacting being conducted non-simultaneously relative to one another.

15. The method of claim 14, further including the step of contacting a fourth portion of the femoral neck with a portion of the surgical clamp to align the opening in the surgical clamp relative to the upper hemisphere of the femoral head.

16. A method for clamping a ball end of a femur, the ball end of the femur having a femoral head and femoral neck, said method including:

positioning a surgical clamp relative to the femoral head, the surgical clamp having a central longitudinal axis and at least two clamping arms each having a distal end adapted to contact the femur;

rotating a portion of the surgical clamp about the central longitudinal axis to move the distal end of at least one of the clamping arms towards the central longitudinal axis of the surgical clamp; and

rotating another portion of the surgical clamp to move the distal end of at least another one of the clamping arms towards the central longitudinal axis of the surgical clamp.

17. Use of the surgical bone clamp as claimed in claim 1 or claim 2 at the ball end of a femur.

18. A surgical bone clamp substantially as hereinbefore described with reference to any one of the figures.

19. A method for clamping a ball end of a femur substantially as hereinbefore described with reference to any one of the figures.

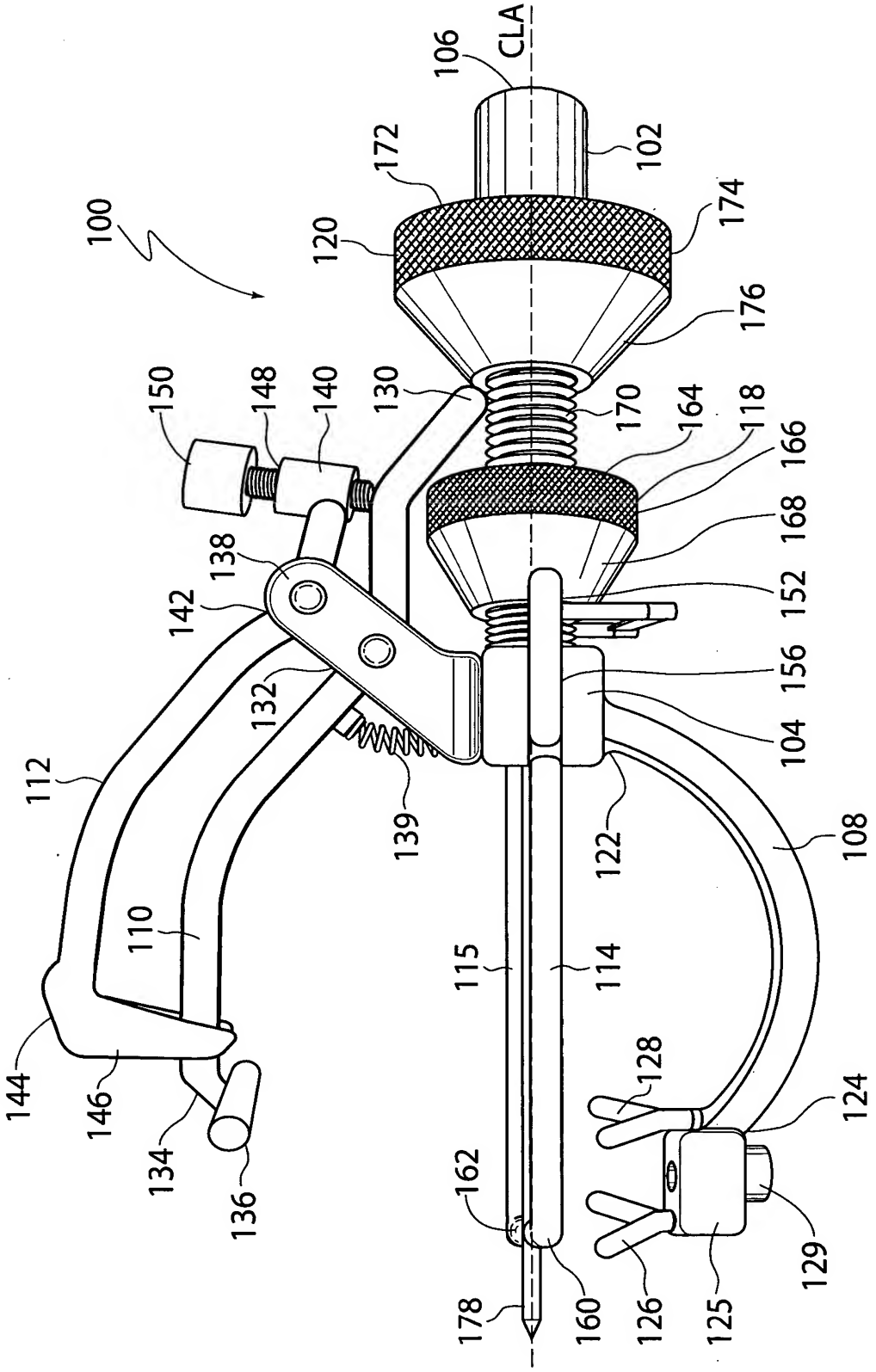
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FIG. 1

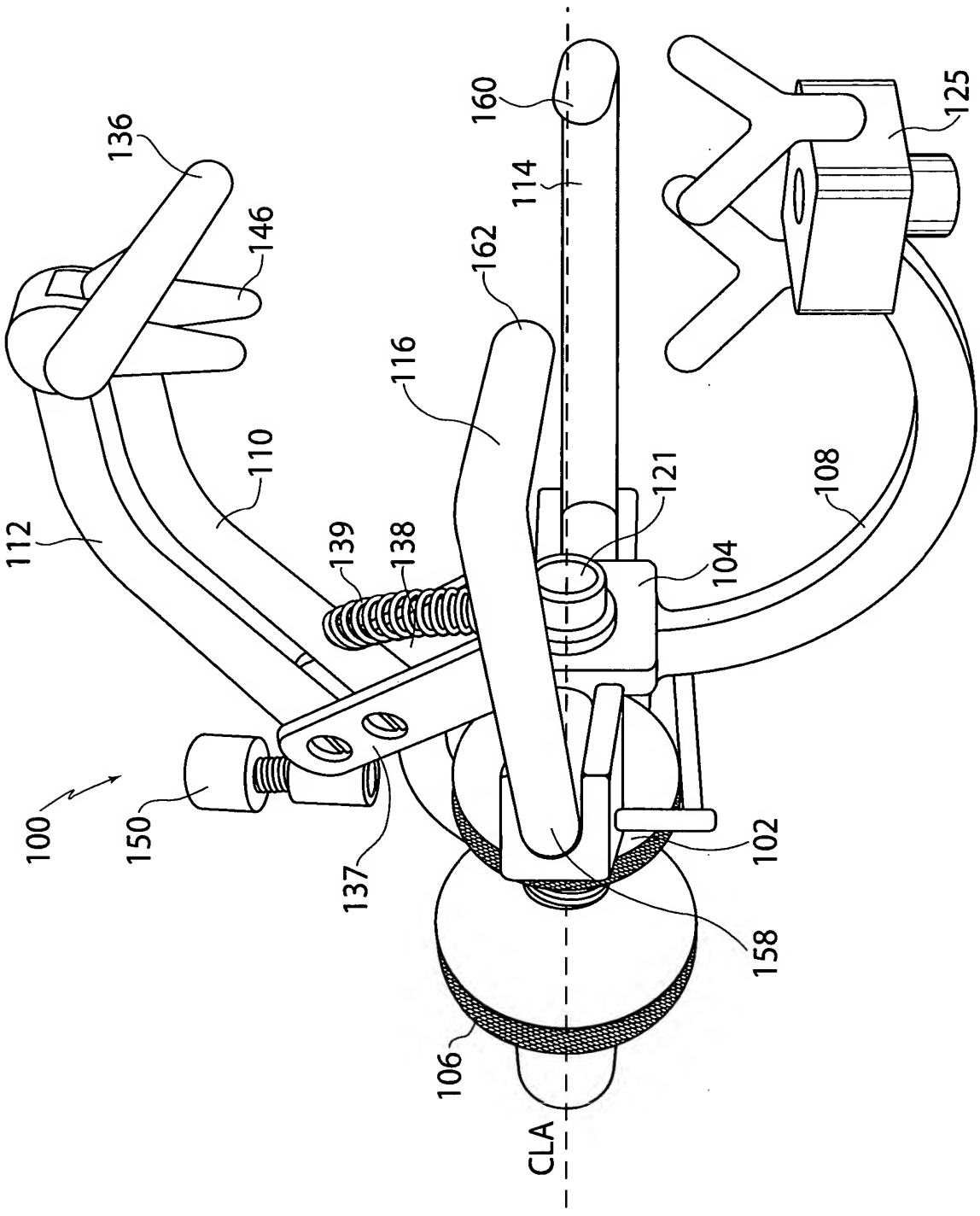
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FIG. 2

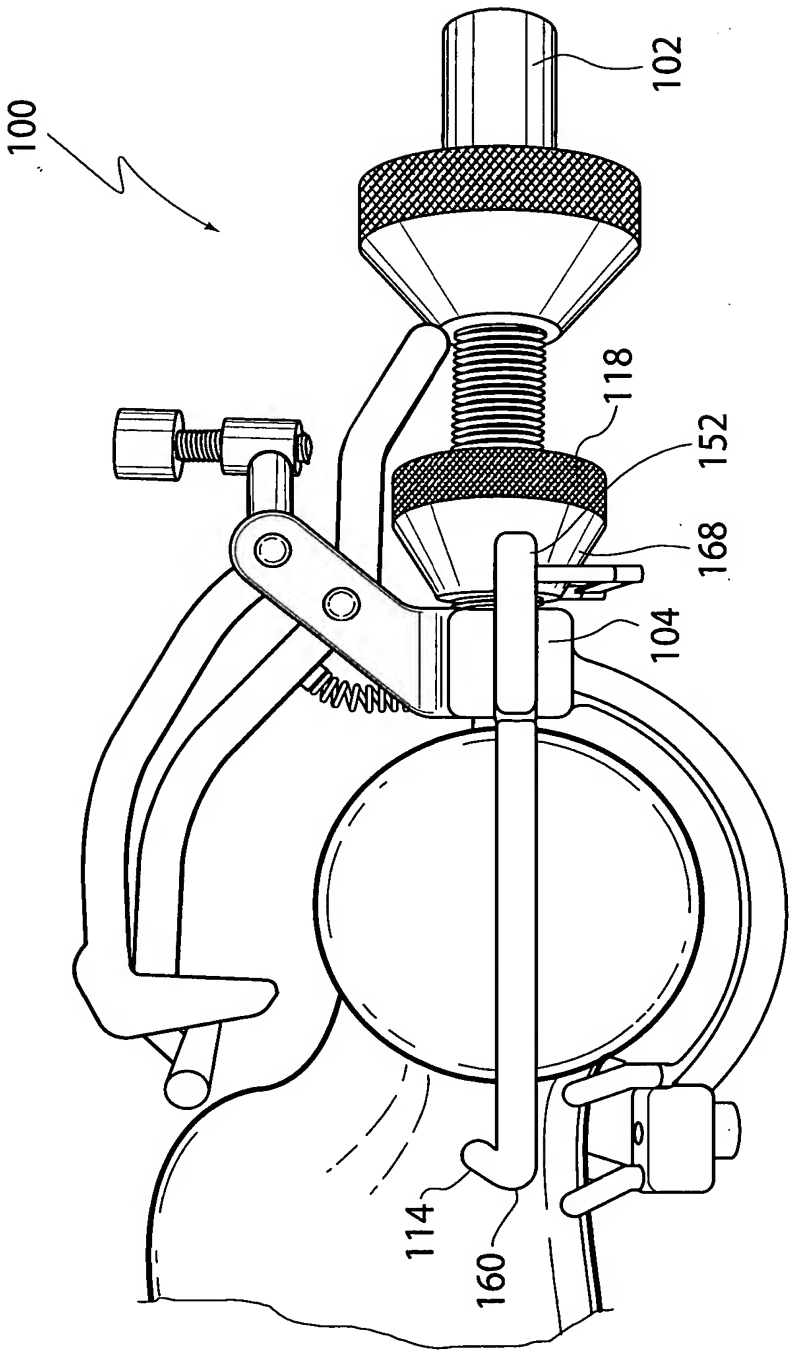

FIG.3

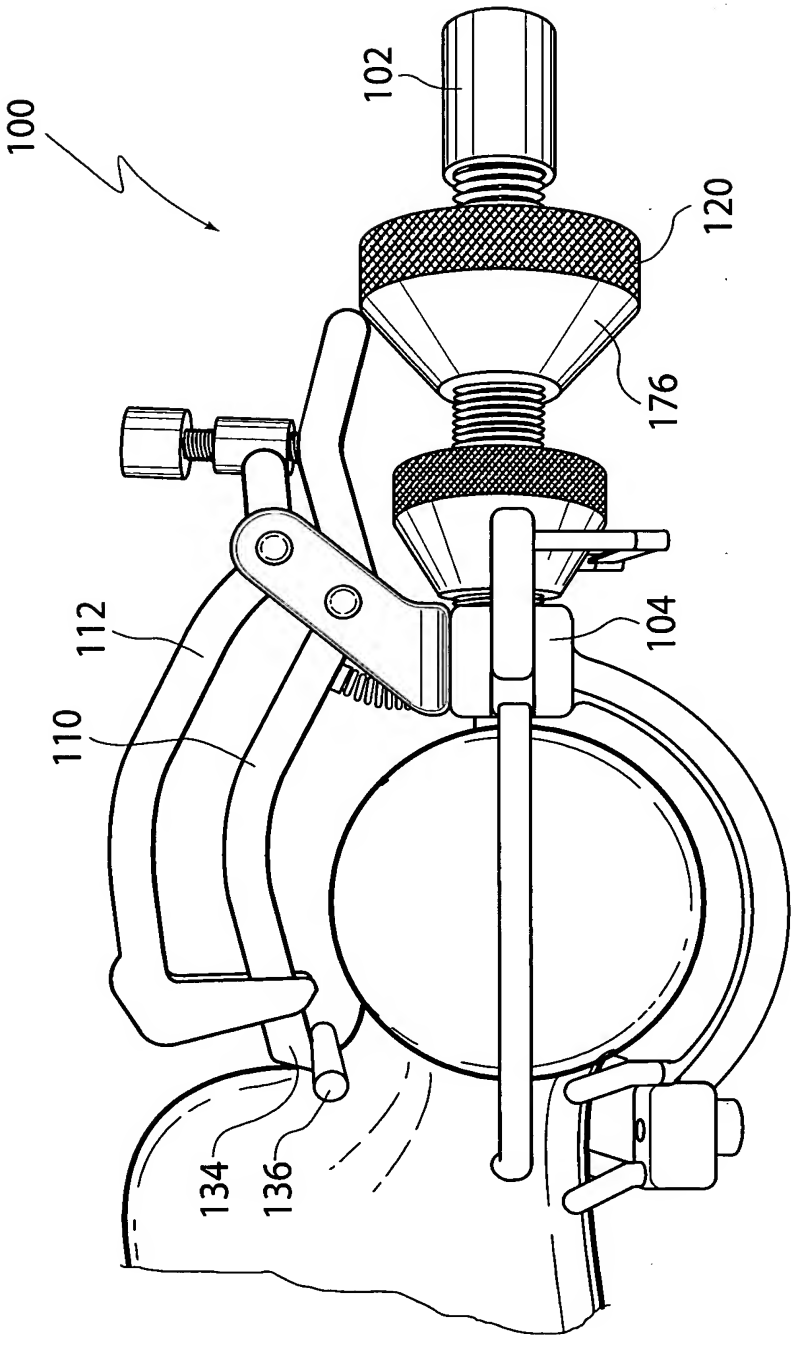

FIG. 4

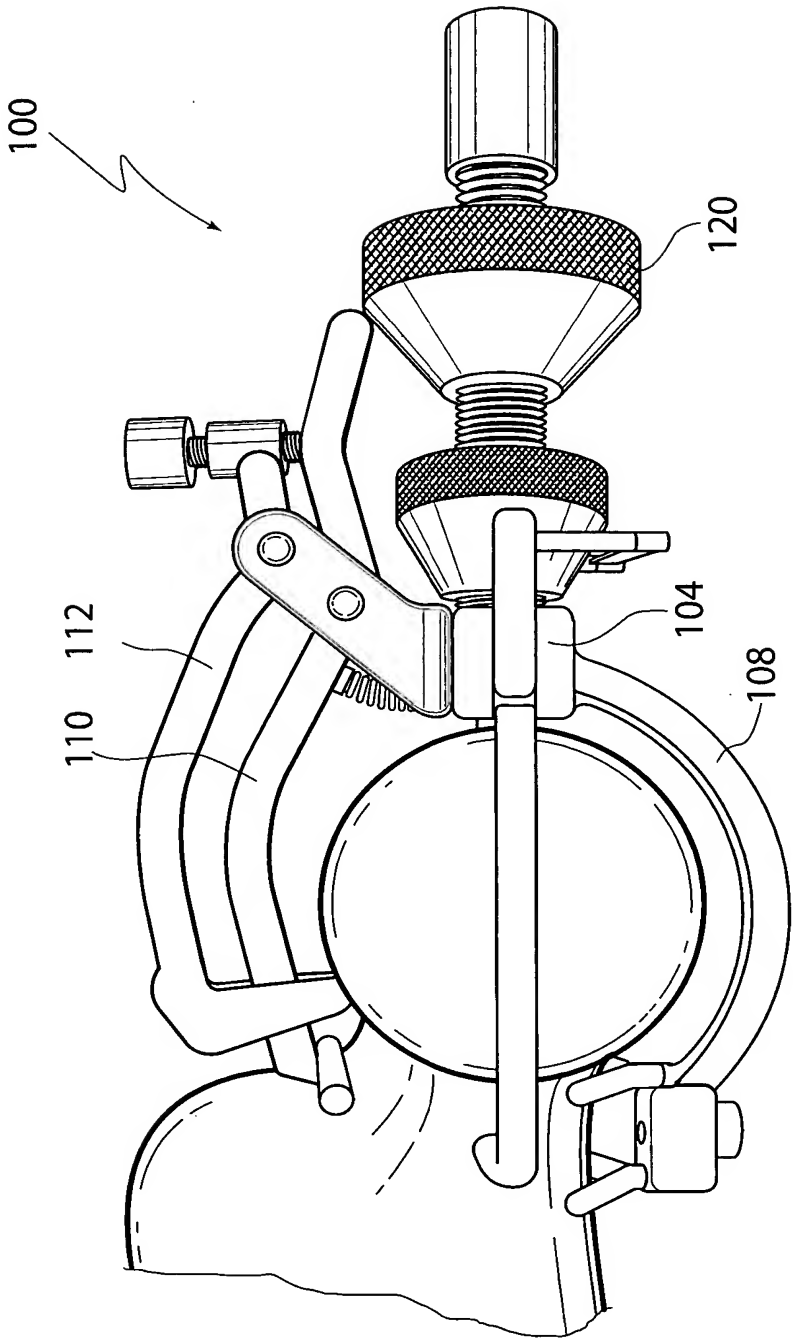

FIG. 5

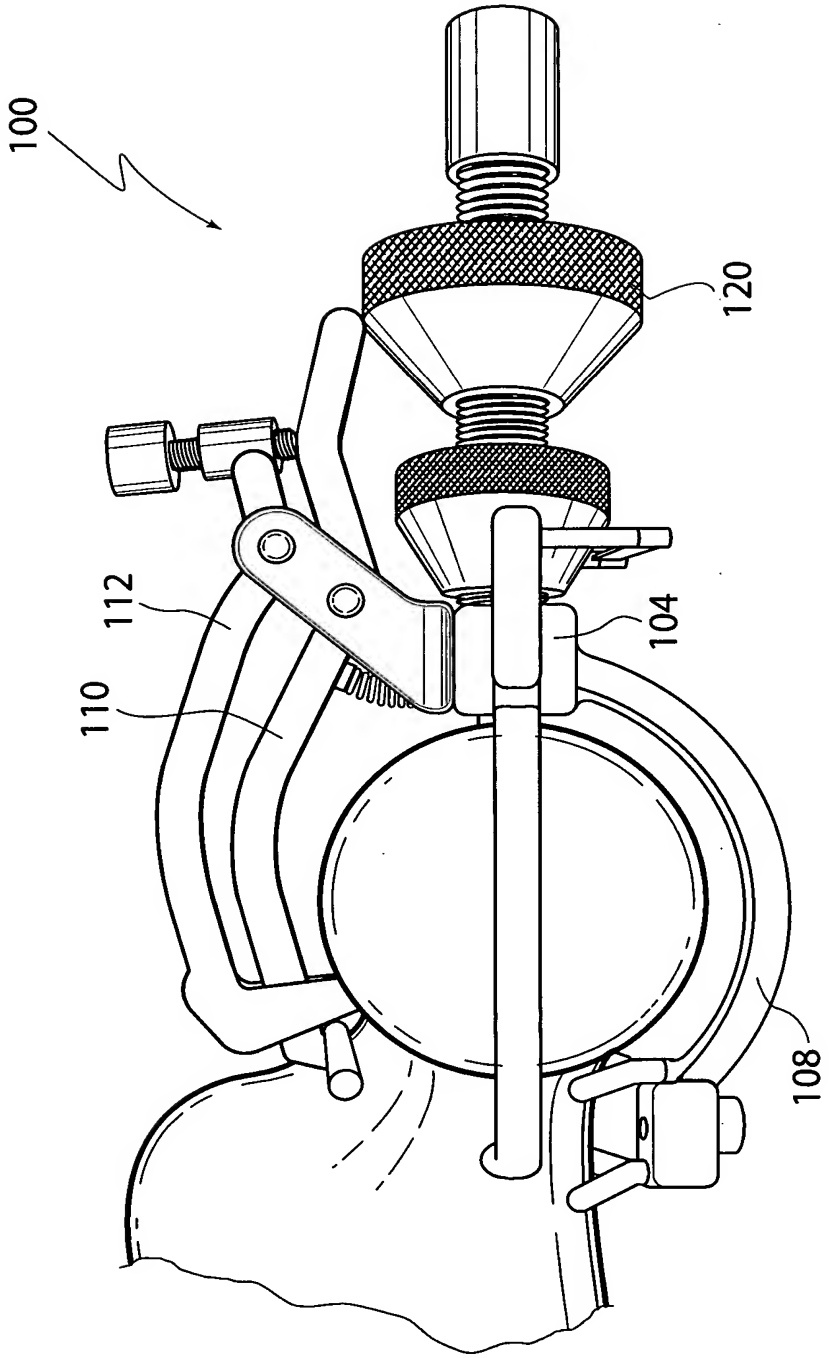

FIG.6

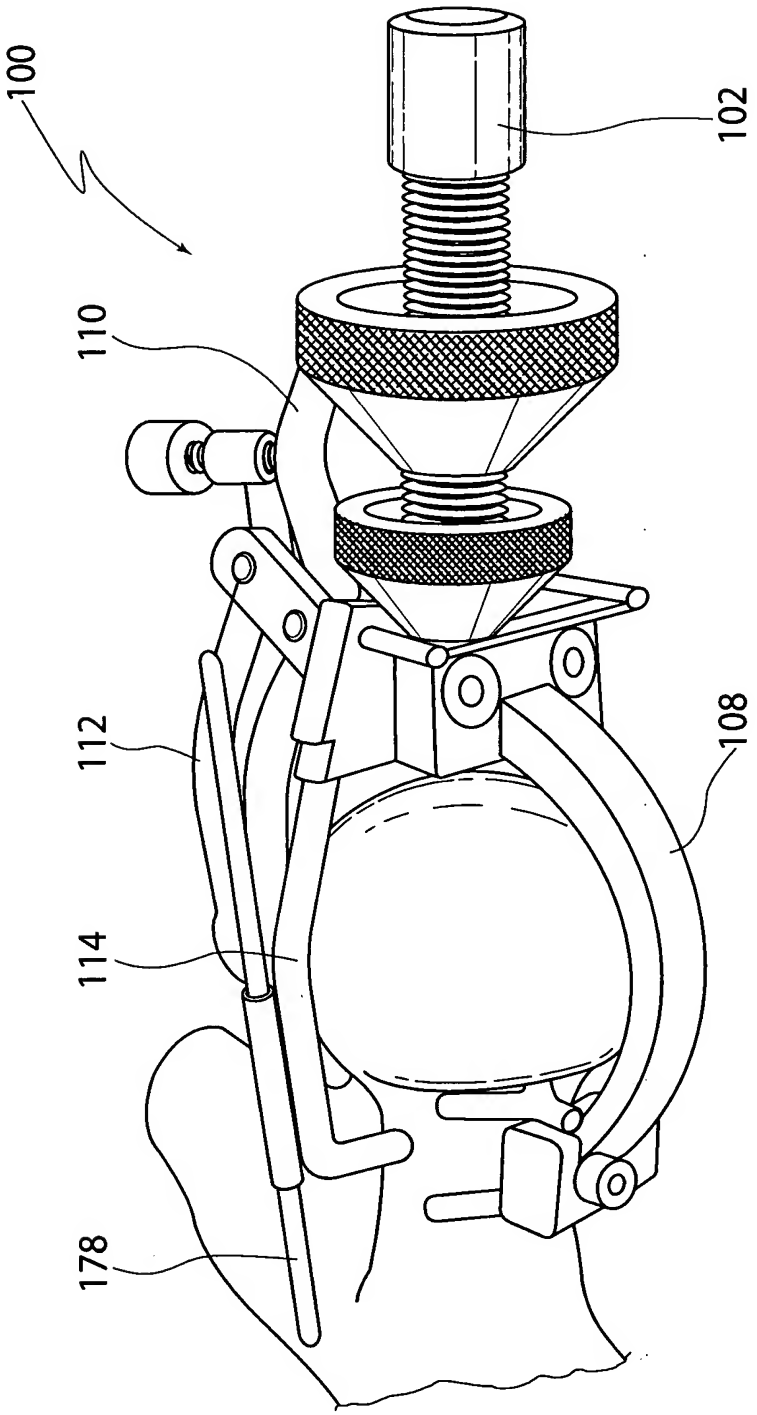

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/000202

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A61B 17/15 (2006.01) *A61B 17/17* (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI: IPC A61F, A61B and keywords: hip, femur, femoral, acetabular, clamp, guide, jig, locate, align, arm, prong, jaw, adjust, manipulate; and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	EP 1813215 A1 (FINSBURY (DEVELOPMENT) LIMITED) 1 August 2007 See whole specification	1-8, 10-19
X Y	US 2005/0113841 A1 (SHELDON et al.) 26 May 2005 See whole specification See whole specification	1-8, 10-19 9
X	EP 1588669 A1 (FINSBURY (DEVELOPMENT) LIMITED) 26 October 2005 See whole specification	16
X Y	US 5624444 A (WIXON et al.) 29 April 1997 See figures 2 and 3 Col. 4, lines 49-56; col. 5, lines 12-25	16 9

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 April 2008	07 MAY 2008
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **A. ALI** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : (02) 6283 2607

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/000202

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4896663 A (VANDEWALLS) 30 January 1990 See figures 2 and 3	16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2008/000202

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See discussion on Supplemental Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Supplemental Box
(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No: III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-15 and 17-19. It is considered that a first clamping arm, a second clamping arm and a third clamping arm comprises a first distinguishing feature.

- Claim 16. It is considered that at least two clamping arms (could be a minimum of two clamping arms and a maximum which is indefinite) comprises a second distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori.*

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2008/000202

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member
EP 1813215	US 2007233136
US 2005/0113841	
EP 1588669	EP 1588668 EP 1852072 US 2005245934 US 2005245936 US 2006052876
US 5624444	
US 4896663	

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX